

REMARKS

The application has been amended in a manner believed to place it in condition for allowance at the time of the next Official Action.

Claims 1 and 8 were amended. Claims 1 and 5-8 remain pending in the application.

Claims 1-3 and 5-8 were rejected under 35 USC 112, second paragraph, as allegedly being indefinite. Applicants respectfully traverse the rejection.

The Official Action stated claims 1 and 8 included improper Markush language. Claims 1 and 8 have been amended to include proper Markush language.

Therefore, applicants respectfully request that the indefiniteness rejection be withdrawn.

Claims 1-3 and 5-8 were rejected under 35 USC 102(b) as allegedly being anticipated by or in the alternative under 35 USC 103(a) as allegedly obvious over WESSLING, TAJIMA et al. or SUMITA et al. Applicants respectfully traverse the rejection.

Claims 1 and 5-7 are directed to methods of preparing an electrically conductive polymer blend. Claim 8 is directed to an electrically conductive polymer blend. The claims recite the blend comprises at least two polymeric materials that form a continuous three-dimensional phase and a non-dispersing phase. The non-dispersing phase comprises at least one polymeric material selected from the group consisting of

polymethylmethacrylate, styrene/acrylonitrile copolymer, polyoxymethylene and liquid crystal polymer. An electrically conductive material containing a metal is dispersed within the continuous three-dimensional phase. The electrically conductive material has a surface tension lower than the surface tension of each of the polymeric materials, and, as recited further in claims 1 and 8, the polymeric material forming the continuous three-dimensional phase has a surface tension at least 2 mN/m lower than the surface tension of the polymeric material forming the non-dispersing phase.

None of the references offered in the Official Action teach or suggest the recited electrically conductive polymer blends having an electrically conductive material containing metal that has a surface tension lower than the surface tension of the polymeric material. Nor do any of the references disclose or suggest that the surface tension of the continuous three-dimensional phase polymeric material is at least 2 mN/m lower than the non-dispersing phase polymeric material, wherein the non-dispersing phase comprises at least one polymeric material selected from the group consisting of polymethylmethacrylate, styrene/acrylonitrile copolymer, polyoxymethylene and liquid crystal polymer.

As requested by the Examiner in the interview of April 4, 2006, applicants are providing surface tension data for the materials disclosed in the references with this response.

Appendix 1 (Diebold) discloses that titanium dioxide has a surface tension of around  $0.35\text{--}2.07\text{ J/m}^2$ , which is the equivalent to  $35\text{--}2000\text{ mN/m}$ .

Appendix 2 (Wiley) includes the surface tension data that was incorporated by reference in the present specification at page 5.

Appendix 3 (Yuchun et al.) discloses potassium titanate whiskers have a surface tension similar to nylon 6.

WESSLING teaches a continuous three-dimensional phase of polymer A, which may include EVA, PA 6 and PA 12, and a non-dispersing phase made of polymer B, which includes PBC, PA 6, PE and POM. However, WESSLING fails to disclose or suggest an electrically conductive material containing metal, as recited in claims 1 and 5-8.

TAJIMA et al. disclose a continuous phase A, which includes PBP and a non-dispersing phase C, which includes PE, and an electrically conductive material, such as titanium dioxide. As evidenced by WILEY, the surface tension of PBT is  $34\text{ mN/m}$  and PE is  $27\text{ mN/m}$ . As evidenced by DIEBOLD, titanium dioxide has a surface tension of  $0.35\text{--}2.07\text{ J/m}^2$ , or  $250\text{--}2070\text{ mN/m}$ . Thus, TAJIMA et al. do not teach the electrically conductive material containing a metal has a surface tension lower than the surface tension of the polymeric materials, wherein the non-dispersing phase comprises at least one polymeric material selected from the

group consisting of polymethylmethacrylate, styrene/acrylonitrile copolymer, polyoxymethylene and liquid crystal polymer, as recited in claims 1 and 5-8.

SUMITA et al. teach a filler predominantly dispersed phase of PE and PMMA and a non-dispersing phase of PP. SUMITA et al. further teach a composition that includes potassium titanate as a possible electrically conductive material containing metal. As evidenced by WILEY, the surface tension of PE is 35, of PP is 29 and PMMA is 41. As evidenced by YUCHEN, the surface tension of potassium titanate is similar to the surface tension of nylon 6, which according to WILEY is about 38 mN/m. Thus, SUMITA et al. fail to disclose or suggest an electrically conductive material containing a metal having a surface tension lower than the surface tension of each of the polymeric materials, wherein the non-dispersing phase comprises at least one polymeric material selected from the group consisting of polymethylmethacrylate, styrene/acrylonitrile copolymer, polyoxymethylene and liquid crystal polymer, as recited in the claimed invention.

Therefore, not only do the references fail to anticipate the claims, they also fail to render the claims obvious. Applicants respectfully request that the anticipation and obviousness rejections be withdrawn.

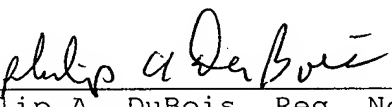
In view of the present amendment and foregoing Remarks, therefore, applicants believe that the present application is in

condition for allowance at the time of the next Official Action. Allowance and passage to issue on that basis is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON

  
Philip A. DuBois, Reg. No. 50,696  
745 South 23<sup>rd</sup> Street  
Arlington, VA 22202  
Telephone (703) 521-2297  
Telefax (703) 685-0573  
(703) 979-4709

PD/lrs

APPENDICES:

1. Diebold, U., "The surface science of titanium oxide", Surface Science Reports 48 (2003) 53-229.

2. A list disclosed in Polymer Handbook (Wiley).  
Surface tension values lie between 22.6 - 52.6.

3. Yuchun, O. et al., "Interfacial interaction and mechanical properties of nylon-6 potassium titanate composites prepared by in-situ polymerization", State Key Laboratory of Engineering Plastics, Institute of Chemistry, Chinese Academy of Sciences, Beijing, 1996.

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# The surface science of titanium dioxide

Ulrike Diebold\*

Department of Physics, Tulane University, New Orleans, LA 70118, USA

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## 2.5. Vicinal and other rutile surfaces

Vicinal surfaces of  $\text{TiO}_2$  have not been studied extensively. A study of Na adsorption on a stepped (4 4 1) surface was reported by Onishi et al. [205]. Unpublished experiments from this author's laboratory with a similarly cut crystal showed macroscopic faceting upon annealing.

The most detailed investigation was performed recently on a  $\text{TiO}_2(2\ 1\ 0)$  surface [206]. In a formal sense,  $\text{TiO}_2(2\ 1\ 0)$  lies midway between (1 1 0) and (1 0 0), and is the most simple vicinal surface. Atomistic simulations, based on Coulombic interaction between ions and a short-range repulsive interaction, predicted an asymmetric sawtooth-like structure of the surface, consisting of {1 1 0} nanofacets. The width of each nanofacet is 1.5 times the width of the surface unit cell of the (1 1 0)–(1 × 1) structure (i.e.  $3a/\sqrt{2}$ ). The nanofacets terminate with a row of Ti atoms carrying bridging oxygen atoms. The surface energy of this structure is predicted to be  $2.07\text{ J/m}^2$ . (This is to be compared to a surface energy of  $1.78\text{ J/m}^2$  derived using a similar calculation for  $\text{TiO}_2(1\ 1\ 0)$  [206].) STM images showed a (1 × 1)-terminated surface that could be consistent with this structure, although the interpretation was again made difficult by balancing electronic effects with the very strong corrugations of this surface.

The structure of the  $\text{TiO}_2(1\ 1\ 1)$  surface was investigated by Onishi and co-workers [207] with LEED and STM. Depending on the annealing temperature, the surface shows a variety of reconstructions.

## 4.1.2. Growth morphology (thermodynamic equilibrium)

It is useful (though a quite rough oversimplification, see below) to distinguish three film growth modes in thermodynamic equilibrium. When the difference between the surface free energy of the clean substrate,  $\gamma_{\text{substrate}}$ , and surface free energy of the overlayer metal,  $\gamma_{\text{metal}}$ , is greater than the interfacial energy,  $\gamma_{\text{interface}}$ , i.e.

$$\gamma_{\text{interface}} > \gamma_{\text{substrate}} - \gamma_{\text{metal}} \quad (4)$$

cluster growth (also called Volmer–Weber growth) should take place. When it is less, the film should wet. For thicker films, growth can proceed in a layer-by-layer fashion (Frank–van der Merwe growth mode). Often, epitaxial strain increases in thicker films and breaks up the overlayer (layer → clusters or Stranski–Krastanov growth mode). Because the surface energy of virtually all clean metals is higher than that of  $\text{TiO}_2$  (where an experimental value of  $\sim 0.35\text{ J/m}^2$  was reported [291]) the term on the left side is negative. Hence, cluster growth should occur, unless  $\gamma_{\text{interface}}$  itself has a *negative* value. It has been suggested [10,63,292] that this is the case for very reactive overlayers, where an interfacial reaction as in Eqs. (1)–(3) is thermodynamically favored.

# APPENDIX 2

Polymeerien pintajännityksiä kirjasta POLYMER HANDBOOK  
(Wiley)

|                            | 20 C<br>mN/m =<br>dyn/cm |
|----------------------------|--------------------------|
| PTFE                       | 23,9                     |
| PA11 (225 C)               | 22,6                     |
| TPX                        | 25                       |
| PP, isotactic              | 29,4                     |
| EVA 82/18                  | 34,1                     |
| PE (LD, Mn7000)            | 35,3                     |
| PA12                       | 35,8                     |
| PA6                        | 38,4                     |
| PS (Mn9300)                | 39,4                     |
| PMMA (M=3000)              | 41,1                     |
| PVC                        | 41,9                     |
| PC (sulasta)               | 42,9                     |
| SAN (33% acrylon.)         | 43                       |
| PET (Mn16000)              | 44,6                     |
| POM (homopolym.)           | 44,6                     |
| PC                         | 45                       |
| PA66                       | 46,5                     |
| PBT(isophalate)            | 47,8                     |
| (acrylonit.-butadien, 3:7) | 52,6                     |



## APPENDIX 3

Tällainen tieto löytyi:

### Interfacial interaction and mechanical properties of nylon 6-potassium titanate composites prepared by in-situ polymerization

Ou Yuchun\*, Yang Feng, Chen Jin

State Key Laboratory of Engineering Plastics, Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100080, People's Republic of China

#### Abstract

A new method was proposed for the synthesis of nylon 6-potassium titanate composites with high strength and high modulus. Dispersion quality of potassium titanate whiskers in the polyamide matrix and the degree of interfacial adhesion between polyamide and whiskers are the key points with  $\epsilon$ -caproamide and potassium titanate whiskers, which were modified by an alkylsilane coupling agent with n-aminocaproic acid as initiator through *in-situ* polymerization. The contact angle test showed that the **surface energy of modified whiskers is similar to nylon 6's, while that of the unmodified ones was much higher than nylon 6's**. These results suggest that the modified whiskers would disperse homogeneously in the nylon 6 matrix. Scanning electronic microscope (SEM) results fortified the above hypothesis. According to infrared (IR) spectra, the sample of whiskers that were separated from the modified composite by formic acid have the characteristic peak of nylon 6's; and the whiskers that were separated from unmodified composite do not have them, which suggested that there are chemical bonds between modified whiskers and nylon 6 matrix, and the whiskers served as chemical cross-link points in the composite. © 1997 John Wiley & Sons, Inc. J Appl Polym Sci 64: 2317-2322, 1997

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\*Correspondence to Ou Yuchun, State Key Laboratory of Engineering Plastics, Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100080, People's Republic of China